

Applicant: Rozenoyer *et al.*
For: METAL MATRIX COMPOSITE

1 1. A metal matrix composite comprising:
2 an isotropic reinforcement preform made by partially sintering ceramic
3 particles; and
4 a metal matrix infused into the preform yielding an isotropic metal matrix
5 composite having an ultimate tensile strength of at least 80 ksi in all directions.

1 2. The metal matrix composite of claim 1 in which the tensile strength is
2 greater than or equal to 100 ksi.

1 3. The metal matrix composite of claim 1 in which the metal matrix
2 composite has an isotropic high temperature strength retention of at least 85% up to
3 500°F.

1 4. The metal matrix composite of claim 1 in which the metal matrix
2 composite has an isotropic high temperature stiffness retention of at least 95% at
3 temperatures up to 500°F.

1 5. The metal matrix composite of claim 1 in which the preform has an
2 average pore size of 1-5 microns, an average interconnected porosity 35-45 vol.%, a
3 100% open porosity, and a flexure strength of greater than 7 ksi.

1 6. The metal matrix composite of claim 1 in which the ceramic particles are
2 substantially pure.

1 7. The metal matrix composite of claim 6 in which the ceramic particles are
2 at least 99.0% pure.

1 8. The metal matrix composite of claim 1 in which the metal matrix material
2 is selected to prevent chemical reaction with the preform.

1 9. The metal matrix composite of claim 1 in which the particles of the
2 preform are selected from the group consisting of alumina and silicon carbide.

1 10. The metal matrix composite of claim 1 in which the metal matrix material
2 is selected from the group consisting of aluminum, aluminum alloys, magnesium,
3 magnesium alloys, copper, and copper alloys.

1 11. The metal matrix composite of claim 10 in which the aluminum is
2 substantially pure aluminum.

1 12. The metal matrix composite of claim 11 in which the aluminum is
2 99.999% pure aluminum.

1 13. The metal matrix composite of claim 10 in which the aluminum alloy is
2 aluminum alloy No. 201.

1 14. The metal matrix composite of claim 1 in which the metal matrix
2 composite has a coefficient of thermal expansion of less than 7.0 ppm/°F.

1 15. A metal matrix composite comprising:
2 a partially sintered reinforcement preform made of ceramic particles; and
3 a metal matrix infused into the preform yielding an isotropic metal matrix
4 composite having a high temperature strength retention of at least 85% up to 500 °F.

1 16. The metal matrix composite of claim 15 in which the ultimate tensile
2 strength of the metal matrix composite is at least 80 ksi in all directions.

1 17. The metal matrix composite of claim 15 in which the metal matrix
2 composite has a high temperature stiffness retention of at least 95% at temperatures up to
3 500°F.

1 18. The metal matrix composite of claim 15 in which the preform has an
2 average pore size of 1-5 microns, an average interconnected porosity 35-45 vol.%, a
3 100% open porosity, and a flexure strength of greater than 7 ksi.

1 19. A metal matrix composite comprising:
2 a partially sintered reinforcement preform made of ceramic particles; and
3 a metal matrix infused into the preform yielding an isotropic metal matrix
4 composite with a high temperature stiffness retention of at least 95% at temperatures up
5 to 500°F.

1 20. The metal matrix composite of claim 19 in which the metal matrix
2 composite has a high temperature strength retention of at least 85% up to 500 °F.

1 21. The metal matrix composite of claim 19 in which the preform has an
2 average pore size of 1-5 microns, an average interconnected porosity of between 35-45
3 vol.%, approximately 100% open porosity, and a flexure strength of greater than 7 ksi.

1 22. The metal matrix composite of claim 19 in which the ultimate tensile
2 strength of the metal matrix composite is at least 80 ksi in all directions.

1 23. A metal matrix composite comprising:
2 a reinforcement preform made by partially sintering ceramic particles to
3 have an average pore size of between 1-5 microns, an average interconnected porosity of
4 between 35-45 vol.%, approximately 100% open porosity, and a flexure strength of
5 greater than 7 ksi, and isotropic properties; and
6 a metal matrix infused into the preform.

1 24. The metal matrix composite of claim 23 in which the metal matrix
2 composite has a high temperature strength retention of at least 85% up to 500 °F.

1 25. The metal matrix composite of claim 23 in which the ultimate tensile
2 strength of the metal matrix composite is at least 80 ksi in all directions.

1 26. The metal matrix composite of claim 23 in which the metal matrix
2 composite has a high temperature stiffness retention of at least 95% at temperatures up to
3 500°F.

1 27. A metal matrix composite comprising:
2 a preform made by partially sintering ceramic particles to have an average
3 pore size of between 1-5 microns, an average interconnected porosity of between 35-45
4 vol.%, approximately 100% open porosity, a flexure strength of greater than 7 ksi, and
5 isotropic properties; and
6 a metal matrix infused into the preform yielding an isotropic metal matrix
7 composite with a high temperature strength retention of at least 85% up to 500°F, high
8 temperature stiffness retention of at least 95% up to 500°F, and an ultimate tensile
9 strength of at least 80 ksi in all directions.

1 28. A method of making a metal matrix composite, the method comprising:
2 partially sintering ceramic particles to form a reinforcement preform
3 having an average pore size of between 1-5 microns, an average interconnected porosity
4 of between 35-45 vol.%, an approximately 100% open porosity, and a flexure strength of
5 greater than 7 ksi; and
6 infusing the partially sintered preform with a metal matrix material.

1 29. The method of claim 28 in which infusion includes subjecting the preform
2 to the molten metal matrix material under pressure.

1 30. The method of claim 29 in which infusion includes pressure casting.

1 31. The method of claim 29 in which infusion includes squeeze casting.

1 32. The method of claim 28 in which the resulting metal matrix composite has
2 a high temperature stiffness retention of at least 95% at temperatures up to 500°F.

1 33. The method of claim 28 in which the resulting metal matrix composite has
2 a high temperature strength retention of at least 85% up to 500°F.

1 34. The method of claim 28 in which the ultimate tensile strength of the
2 resulting metal matrix composite is at least 80 ksi in all directions.

1 35. The method of claim 28 in which the ceramic particles are substantially
2 pure.

1 36. The method of claim 35 in which the ceramic particles are at least 99.0%
2 pure.

1 37. The method of claim 28 in which the metal matrix material is selected to
2 prevent chemical reaction with the preform.

1 38. The method of claim 28 in which the particles of the preform are selected
2 from the group consisting of alumina and silicon carbide.

1 39. The method of claim 28 in which the metal matrix material is selected
2 from the group consisting of aluminum, aluminum alloys, magnesium, magnesium alloys,
3 copper, and copper alloys.

1 40. The method of claim 39 in which the aluminum is substantially pure
2 aluminum